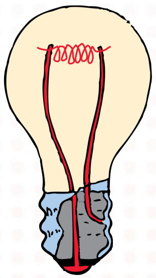


THE BIG IDEA

Light is the ONLY thing you see! All visible objects either emit or reflect light.

**Almost everything we see is made visible by the light it reflects. Some materials, such as air, water, or window glass, allow light to pass through. Other materials, such as thin paper or frosted glass, allow the passage of light in diffused directions so that we can't see objects through them.**

# 27.1 Early Concepts of Light

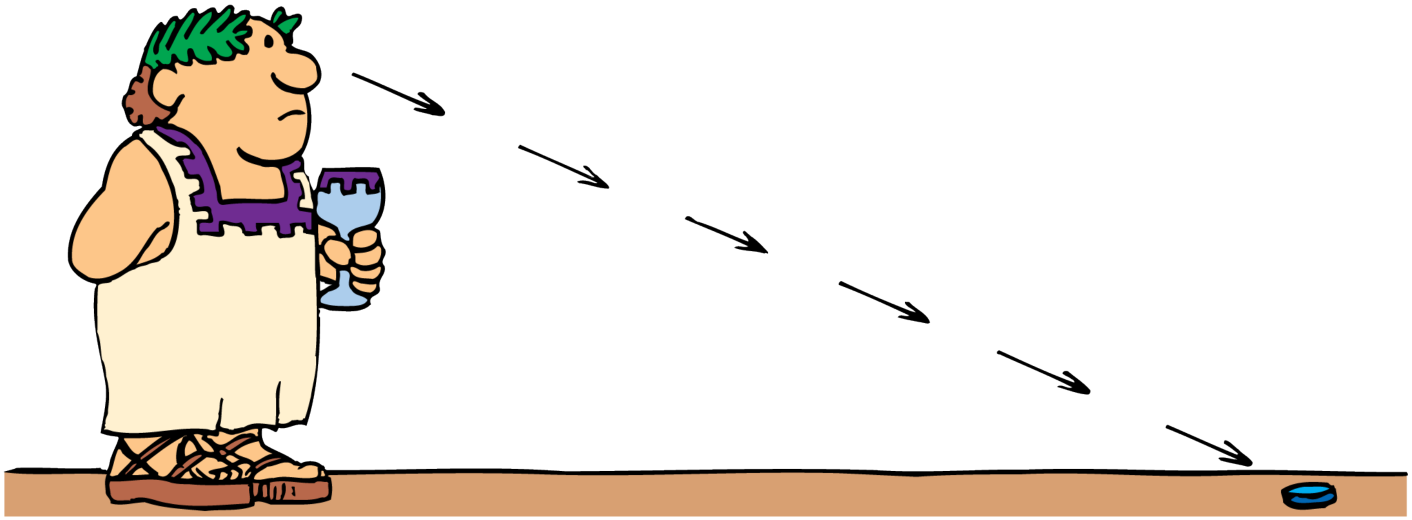
**Scientists now agree that light has a dual nature, part particle and part wave.**

# 27.1 Early Concepts of Light

Light has been studied for thousands of years.

Some ancient Greek philosophers thought that light consists of tiny particles, which enter the eye to create the sensation of vision.

Others thought that vision resulted from streamers or filaments emitted by the eye making contact with an object.



# 27.1 Early Concepts of Light

Up until the time of Newton and beyond, most philosophers and scientists thought that light consisted of particles.

However, one Greek, Empedocles, thought that light traveled in waves.

One of Newton's contemporaries, the Dutch scientist Christian Huygens, also argued that light was a wave.

# 27.1 Early Concepts of Light

The particle theory was supported by the fact that light seemed to move in straight lines instead of spreading out as waves do.

Huygens showed that under some circumstances light does spread out and other scientists found evidence to support the wave theory.

The wave theory became the accepted theory in the nineteenth century.

# 27.1 Early Concepts of Light

In 1905, Einstein published a theory explaining the *photoelectric effect.*

According to this theory, light consists of particles called **photons,** massless bundles of concentrated electromagnetic energy.

Scientists now agree that light has a dual nature, part particle and part wave.

# 27.1 Early Concepts of Light

CONCEPT CHECK

**What is the nature of light?**

# 27.2 The Speed of Light

Michelson's experimental value for the speed of light was 299,920 km/s, which is usually rounded to 300,000 km/s.

# 27.2 The Speed of Light

It was not known whether light travels instantaneously or with finite speed until the late 1600s.

Galileo tried to measure the time a light beam takes to travel to a distant mirror, but it was so short he couldn't begin to measure it.

Others tried the experiment at longer distances with lanterns they flashed on and off between distant mountaintops. All they succeeded in doing was measuring their own reaction times.

# 27.2 The Speed of Light

## Olaus Roemer

The first demonstration that light travels at a finite speed was supplied by the Danish astronomer Olaus Roemer about 1675.

Roemer carefully measured the periods of Jupiter's moons.

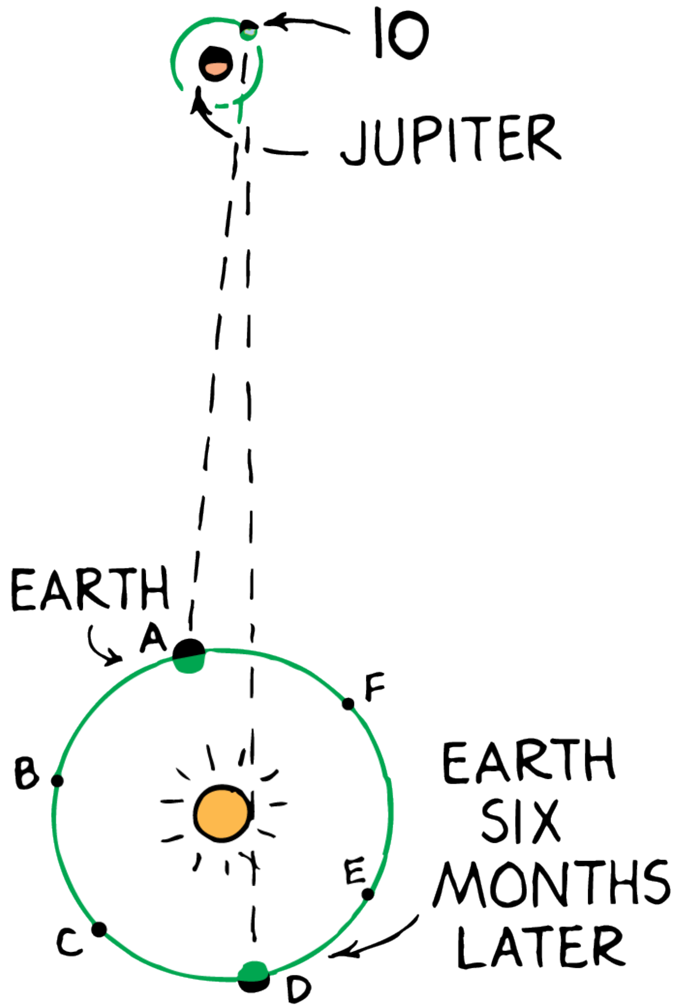
- The innermost moon, Io, revolves around Jupiter in 42.5 hours.
- The Io disappears periodically into Jupiter's shadow, so this period could be measured with great accuracy.

# 27.2 The Speed of Light

- Roemer found that while Earth was moving away from Jupiter, the periods of Io were all somewhat longer than average.
- When Earth was moving toward Jupiter, the measured periods were shorter than average.
- Roemer estimated that the cumulative discrepancy amounted to about 22 minutes.

# 27.2 The Speed of Light

Light coming from Io takes longer to reach Earth at position D than at position A. The extra distance that the light travels divided by the extra time it takes gives the speed of light.



# 27.2 The Speed of Light

## Christian Huygens

Christian Huygens correctly interpreted this discrepancy.

- The Io passed into Jupiter’s shadow at the predicted time.
- The light did not arrive until it had traveled the extra distance across the diameter of Earth’s orbit.
- This distance is now known to be 300,000,000 km.

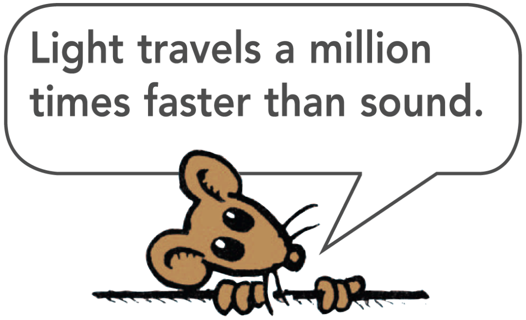
# 27.2 The Speed of Light

Using the travel time of 1000 s for light to move across Earth's orbit makes the calculation of the speed of light quite simple:

$$\text{speed of light} = \frac{d}{t} = \frac{\text{extra distance traveled}}{\text{extra time measured}}$$

$$= \frac{300{,}000{,}000\ \text{km}}{1000\ \text{s}} = 300{,}000\ \text{km/s}$$

The speed of light is 300,000 km/s.



# 27.2 The Speed of Light

## Albert Michelson

The most famous experiment measuring the speed of light was performed by the American physicist Albert Michelson in 1880.

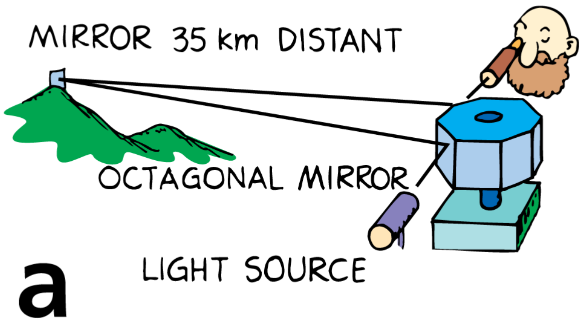
- Light was directed by a lens to an octagonal mirror.
- A beam of light was reflected to a stationary mirror on a mountain 35 km away and then reflected back.
- The distance was known, so Michelson had to find only the time it took to make a round trip.

# 27.2 The Speed of Light

- When the mirror was spun, short bursts of light reached the stationary mirror and were reflected back to the spinning octagonal mirror.
- If the rotating mirror made one-eighth rotation while the light made the trip, the mirror reflected light to the observer.
- If the mirror was rotated too slowly or too quickly, it would not be in a position to reflect light.

# 27.2 The Speed of Light

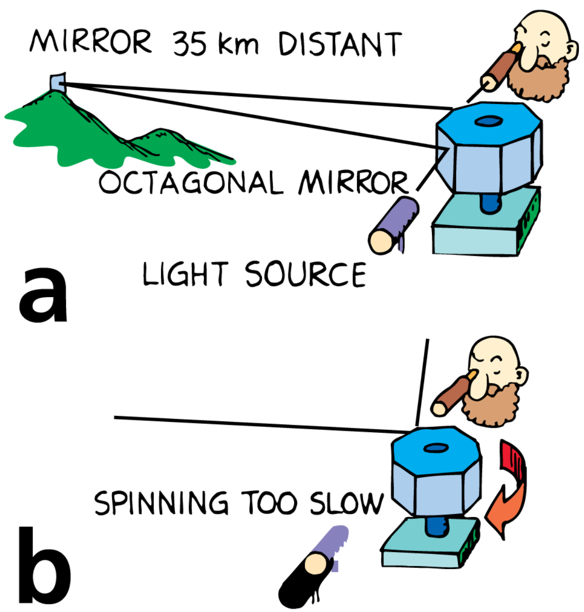
a. Light is reflected back to the eyepiece when the mirror is at rest.



# 27.2 The Speed of Light

a. Light is reflected back to the eyepiece when the mirror is at rest.

b. Reflected light fails to enter the eyepiece when the mirror spins too slowly . . .

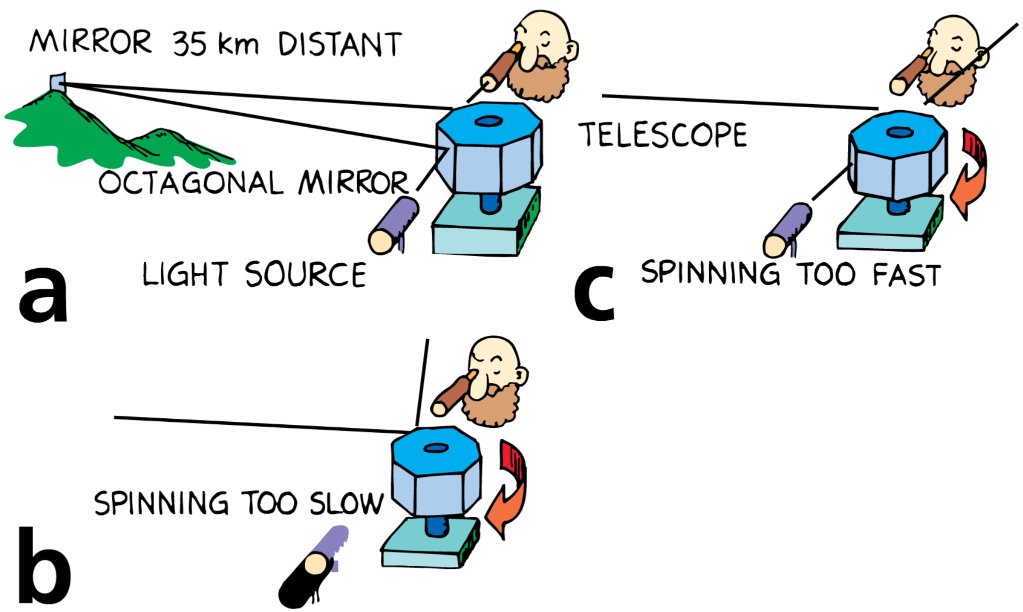


# 27.2 The Speed of Light

a. Light is reflected back to the eyepiece when the mirror is at rest.

b. Reflected light fails to enter the eyepiece when the mirror spins too slowly . . .

c. . . . or too fast.



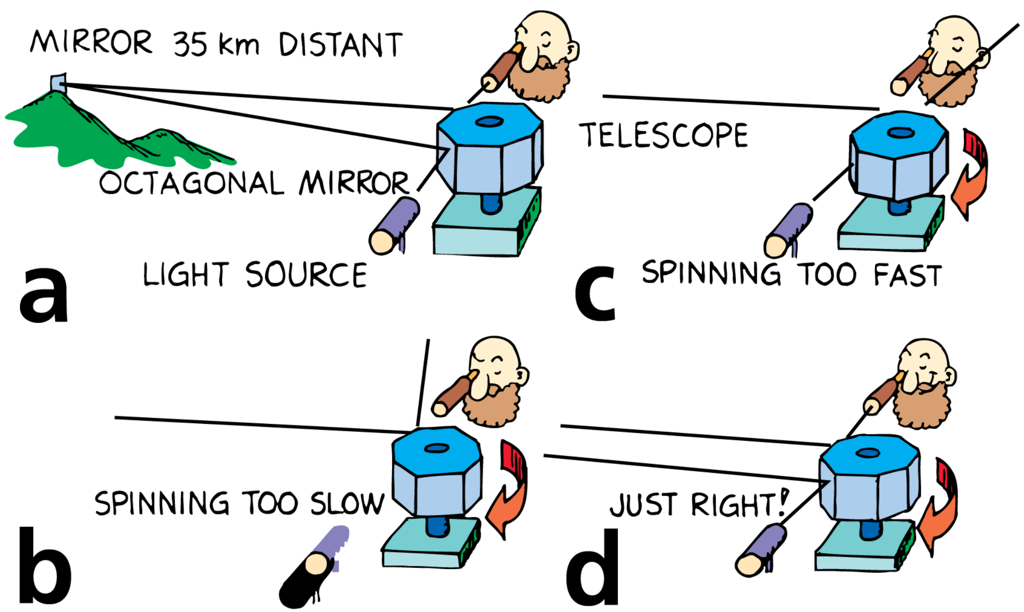
# 27.2 The Speed of Light

a. Light is reflected back to the eyepiece when the mirror is at rest.

b. Reflected light fails to enter the eyepiece when the mirror spins too slowly . . .

c. . . . or too fast.

d. When the mirror rotates at the correct speed, light reaches the eyepiece.



# 27.2 The Speed of Light

When the light entered the eyepiece, the time for the light to make the trip and the time for the mirror to make one eighth of a rotation were the same.

Michelson divided the 70-km round trip distance by this time and found the speed of light was 299,920 km/s, which is usually rounded to 300,000 km/s.

Michelson received the 1907 Nobel Prize in physics for this experiment.

# 27.2 The Speed of Light

The speed of light in a vacuum is a universal constant.

Light is so fast that if a beam of light could travel around Earth, it would make 7.5 trips in one second.

Light takes 8 minutes to travel from the sun to Earth and 4 years from the next nearest star, Alpha Centauri.

The distance light travels in one year is called a **light-year.**

# 27.2 The Speed of Light

## think!

Light entered the eyepiece when Michelson’s octagonal mirror made exactly one eighth of a rotation during the time light traveled to the distant mountain and back. Would light enter the eyepiece if the mirror turned one quarter of a rotation in this time?

# 27.2 The Speed of Light

## think!

Light entered the eyepiece when Michelson's octagonal mirror made exactly one eighth of a rotation during the time light traveled to the distant mountain and back. Would light enter the eyepiece if the mirror turned one quarter of a rotation in this time?

*Answer:*

Yes, light would enter the eyepiece whenever the octagonal mirror turned in multiples of 1/8 rotation— ¼, ½, 1, etc.—in the time the light made its round trip.

# 27.2 The Speed of Light

CONCEPT CHECK

**What was Michelson's experimental value for the speed of light?**

# 27.3 Electromagnetic Waves

**The electromagnetic spectrum consists of radio waves, microwaves, infrared, light, ultraviolet rays, X-rays, and gamma rays.**

# 27.3 Electromagnetic Waves

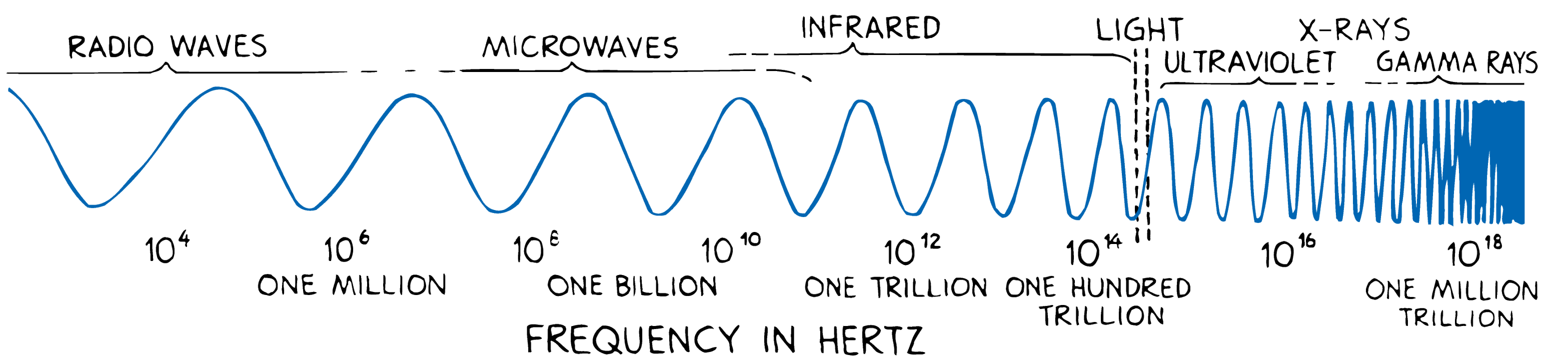
Light is energy that is emitted by accelerating electric charges—often electrons in atoms.

This energy travels in a wave that is partly electric and partly magnetic. Such a wave is an **electromagnetic wave.**

# 27.3 Electromagnetic Waves

Light is a portion of the family of electromagnetic waves that includes radio waves, microwaves, and X-rays.

The range of electromagnetic waves is called the **electromagnetic spectrum.**



# 27.3 Electromagnetic Waves

The lowest frequency of light we can see appears red. The highest visible light, violet, has nearly twice the frequency of red light.

Electromagnetic waves of frequencies lower than the red of visible light are called **infrared.** Heat lamps give off infrared waves.

Electromagnetic waves of frequencies higher than those of violet are called **ultraviolet.** They are responsible for sunburns.

# 27.3 Electromagnetic Waves

CONCEPT CHECK

**What are the waves of the electromagnetic spectrum?**

# 27.4 Light and Transparent Materials

Light passes through materials whose atoms absorb the energy and immediately reemit it as light.

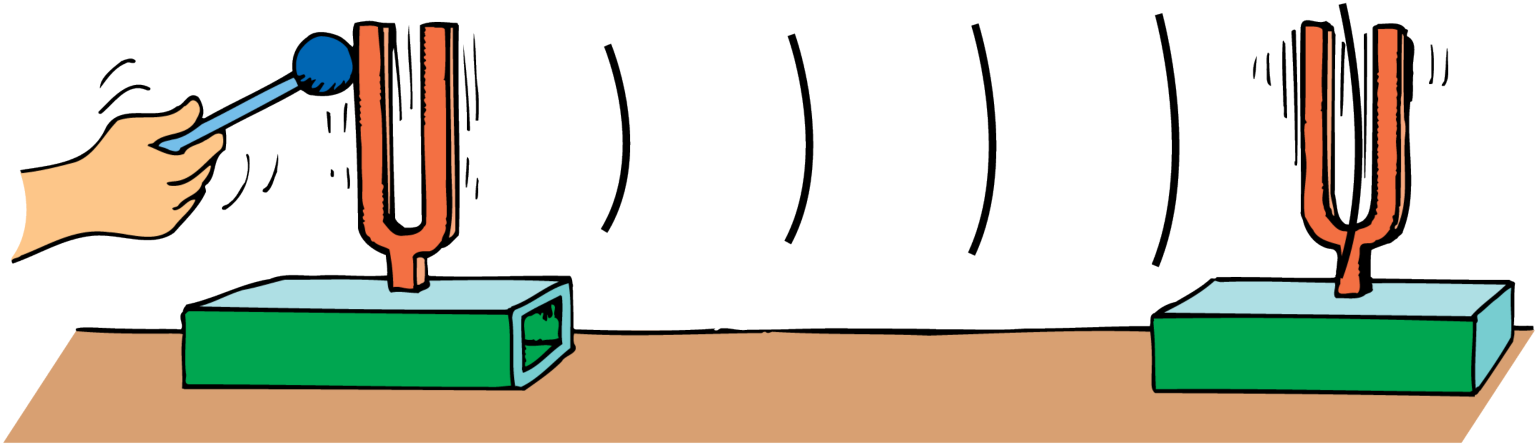
# 27.4 Light and Transparent Materials

Light is energy carried in an electromagnetic wave, generated by vibrating electric charges.

When light strikes matter, electrons in the matter are forced into vibration.

# 27.4 Light and Transparent Materials

Just as a sound wave can force a sound receiver into vibration, a light wave can force charged particles in materials into vibration.



# 27.4 Light and Transparent Materials

Exactly how a material responds to light depends on the frequency of light and the natural frequency of electrons in the material.

Visible light vibrates at a very high rate, more than 100 trillion times per second ($10^{14}$ hertz).

To respond to these ultrafast vibrations, a particle must have very little inertia. Electrons, with their small mass, can vibrate this fast.

# 27.4 Light and Transparent Materials

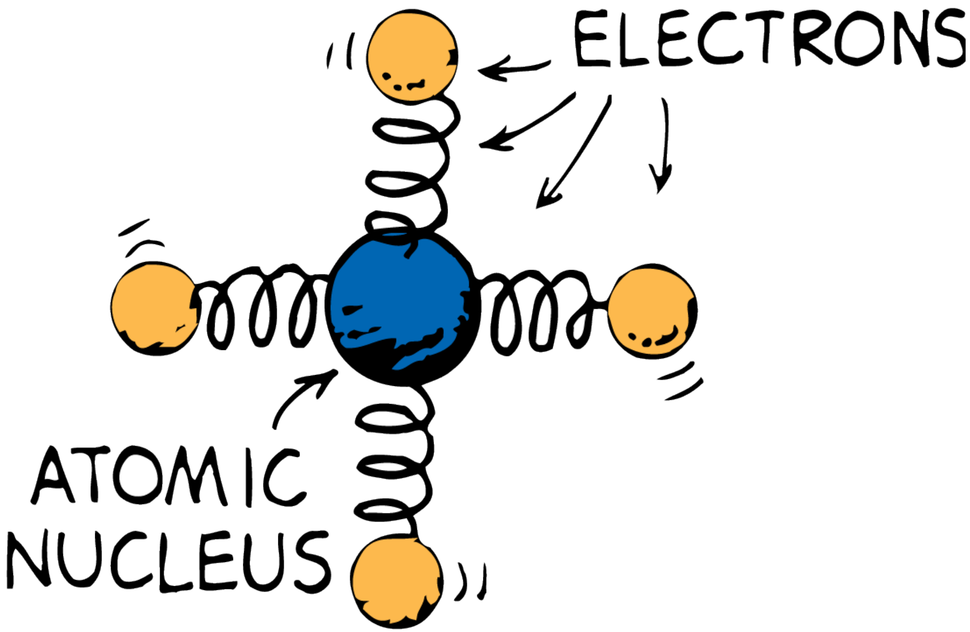
Materials that transmit light are **transparent.** Glass and water are transparent.

Materials that are springy (elastic) respond more to vibrations at some frequencies than at others.

The natural vibration frequencies of an electron depend on how strongly it is attached to a nearby nucleus.

# 27.4 Light and Transparent Materials

The electrons of atoms in glass can be imagined to be bound to the atomic nucleus as if connected by springs.



# 27.4 Light and Transparent Materials

Electrons in glass have a natural vibration frequency in the ultraviolet range.

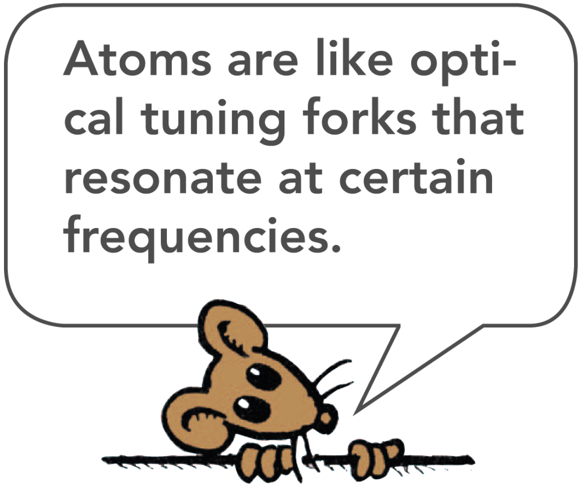
- In ultraviolet light, resonance occurs as the wave builds a large vibration between the electron and the nucleus.
- The energy received by the atom can be either passed on to neighboring atoms by collisions or reemitted as light.
- If ultraviolet light interacts with an atom that has the same natural frequency, the vibration amplitude is unusually large.

# 27.4 Light and Transparent Materials

The atom typically holds on to this energy for about 1 million vibrations or 100 millionths of a second.

During this time, the atom makes many collisions with other atoms and gives up its energy in the form of heat.

That's why glass is not transparent to ultraviolet.



# 27.4 Light and Transparent Materials

When the electromagnetic wave has a lower frequency than ultraviolet, as visible light does, the electrons are forced into vibration with smaller amplitudes.

- The atom holds the energy for less time, with less chance of collision with neighboring atoms.
- Less energy is transferred as heat.
- The energy of the vibrating electrons is reemitted as transmitted light.

# 27.4 Light and Transparent Materials

Glass is transparent to all the frequencies of visible light.

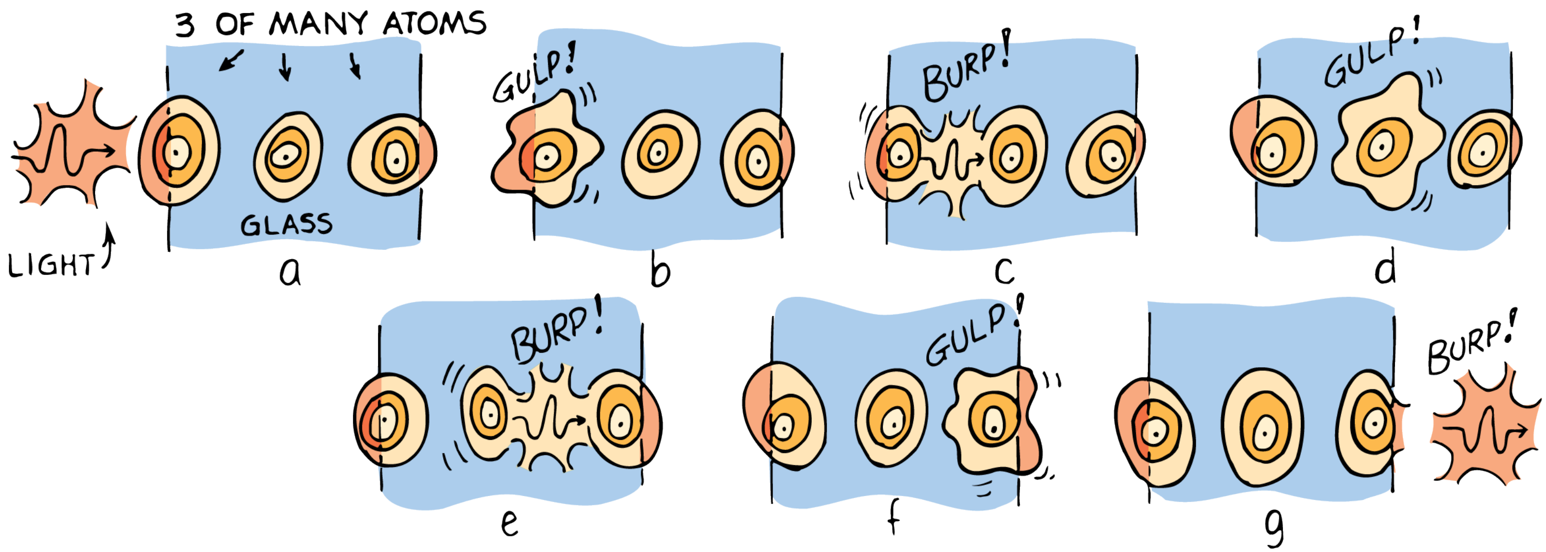
The frequency of the reemitted light is identical to that of the light that produced the vibration to begin with.

The main difference is a slight time delay between absorption and reemission.

This time delay results in a lower average speed of light through a transparent material.

# 27.4 Light and Transparent Materials

A light wave incident upon a pane of glass sets up vibrations in the atoms. Because of the time delay between absorptions and reemissions, the average speed of light in glass is less than *c*.



# 27.4 Light and Transparent Materials

In a vacuum, the speed of light is a constant 300,000 km/s; we call this speed of light *c.*

- Light travels slightly less than *c* in the atmosphere, but the speed is usually rounded to *c*.
- In water, light travels at 75% of its speed in a vacuum, 0.75*c.*
- In glass, light travels at about 0.67*c,* depending on glass type.
- In a diamond, light travels at only 0.40*c*.

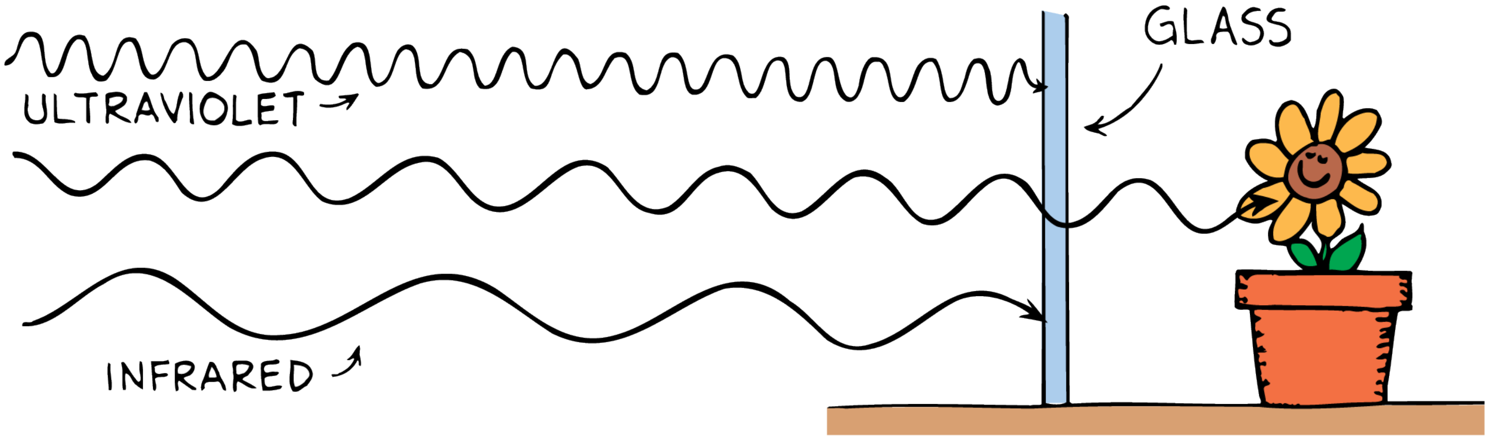
When light emerges from these materials into the air, it travels at its original speed, *c.*

# 27.4 Light and Transparent Materials

Infrared waves, with frequencies lower than visible light, vibrate not only the electrons, but also the entire structure of the glass.

This vibration of the structure increases the internal energy of the glass and makes it warmer.

Glass is transparent to visible light, but not to ultraviolet and infrared light.



# 27.4 Light and Transparent Materials

CONCEPT CHECK

**What kind of materials does light pass through?**

# 27.5 Opaque Materials

In opaque materials, any coordinated vibrations given by light to the atoms and molecules are turned into random kinetic energy—that is, into internal energy.

# 27.5 Opaque Materials

Materials that absorb light without reemission and thus allow no light through them are **opaque.**

Wood, stone, and people are opaque.

In opaque materials, any vibrations from light are turned into random kinetic energy—that is, into internal energy.

The materials become slightly warmer.

# 27.5 Opaque Materials

Metals are also opaque.

In metals, the outer electrons of atoms are not bound to any particular atom.

When light shines on metal and sets these free electrons into vibration, their energy does not “spring” from atom to atom.

It is reemitted as visible light. This reemitted light is seen as a reflection. That’s why metals are shiny.

# 27.5 Opaque Materials

Our atmosphere is transparent to visible light and some infrared, but almost opaque to high-frequency ultraviolet waves.

The ultraviolet that gets through is responsible for sunburns.

Clouds are semitransparent to ultraviolet, so you can get a sunburn on a cloudy day.

Ultraviolet also reflects from sand and water, so you can sometimes get a sunburn while in the shade of a beach umbrella.

# 27.5 Opaque Materials

## think!

Why is glass transparent to visible light but opaque to ultraviolet and infrared?

# 27.5 Opaque Materials

## think!

Why is glass transparent to visible light but opaque to ultraviolet and infrared?

*Answer:*

The natural frequency of vibration for electrons in glass matches the frequency of ultraviolet light, so resonance in the glass occurs when ultraviolet waves shine on it. These vibrations generate heat instead of wave reemission, so the glass is opaque to ultraviolet. In the range of visible light, the forced vibrations of electrons in the glass result in reemission of light, so the glass is transparent. Lower-frequency infrared causes entire atomic structures to resonate so heat is generated, and the glass is opaque.

# 27.5 Opaque Materials

CONCEPT CHECK

**Why does light not pass through opaque materials?**

# 27.6 Shadows

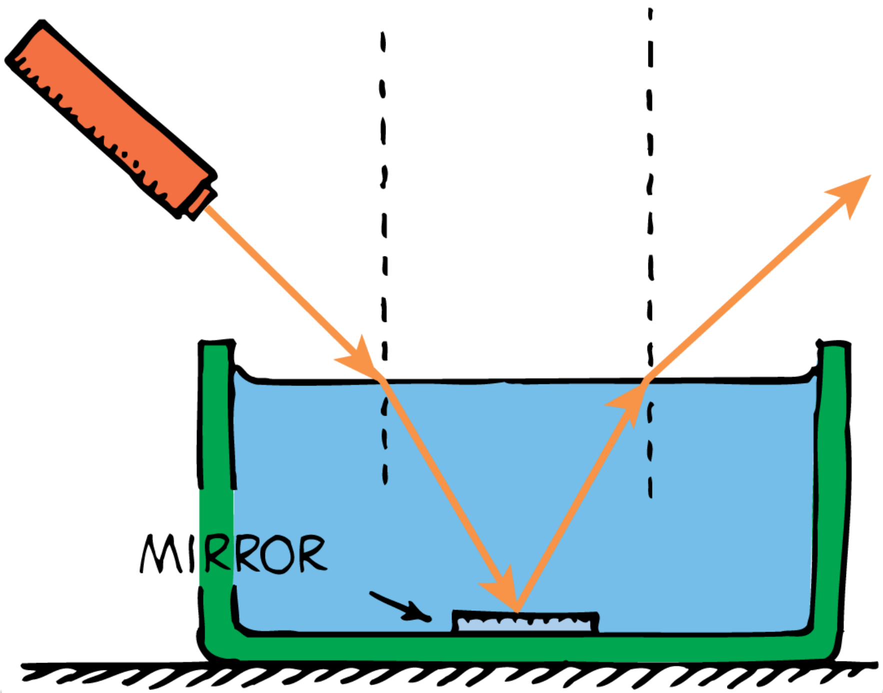
When light shines on an object, some of the rays may be stopped while others pass on in a straight-line path.

# 27.6 Shadows

A thin beam of light is often called a **ray.**

Any beam of light—no matter how wide—can be thought of as made of a bundle of rays.

A **shadow** is formed where light rays cannot reach.



# 27.6 Shadows

Sharp shadows are produced by a small light source nearby or by a larger source farther away.

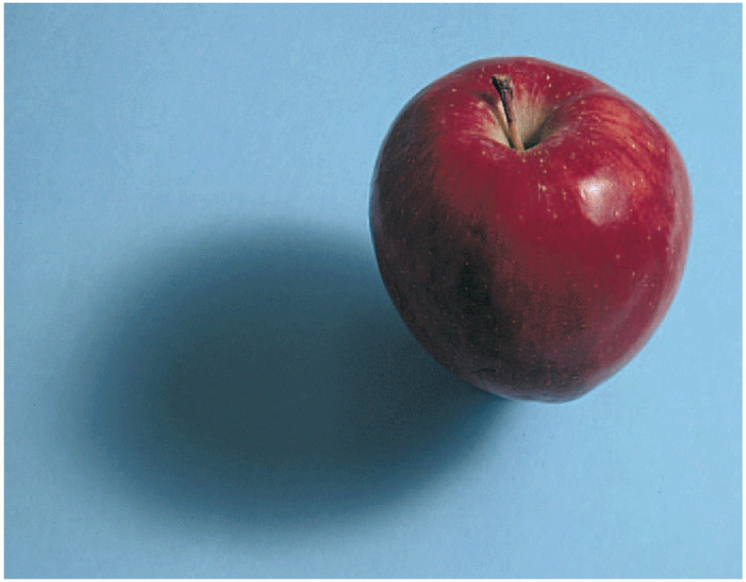
However, most shadows are somewhat blurry, with a dark part on the inside and a lighter part around the edges.

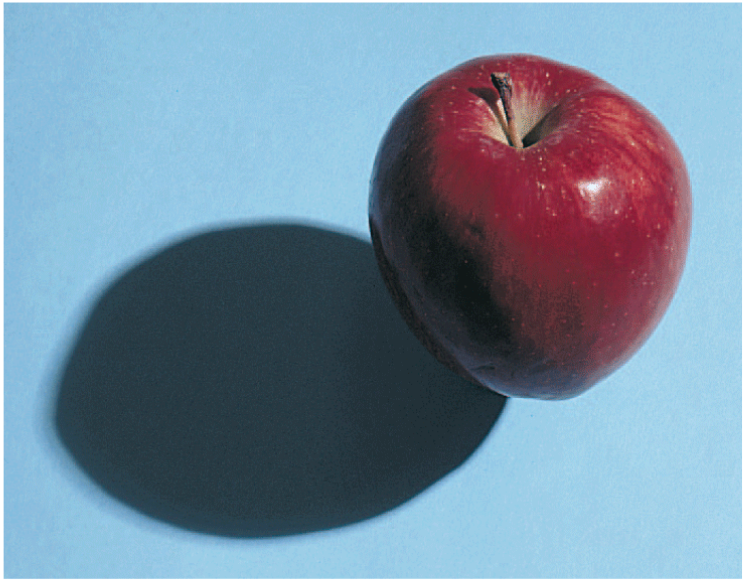
A total shadow is called an **umbra.**

A partial shadow is called a **penumbra.** A penumbra appears where some of the light is blocked but where other light fills in.

# 27.6 Shadows

A large light source produces a softer shadow than a smaller source.





# 27.6 Shadows

a. An object held close to a wall casts a sharp shadow.

a

# 27.6 Shadows

a. An object held close to a wall casts a sharp shadow.

b. As the object is moved farther away, penumbras are formed and cut down on the umbra.

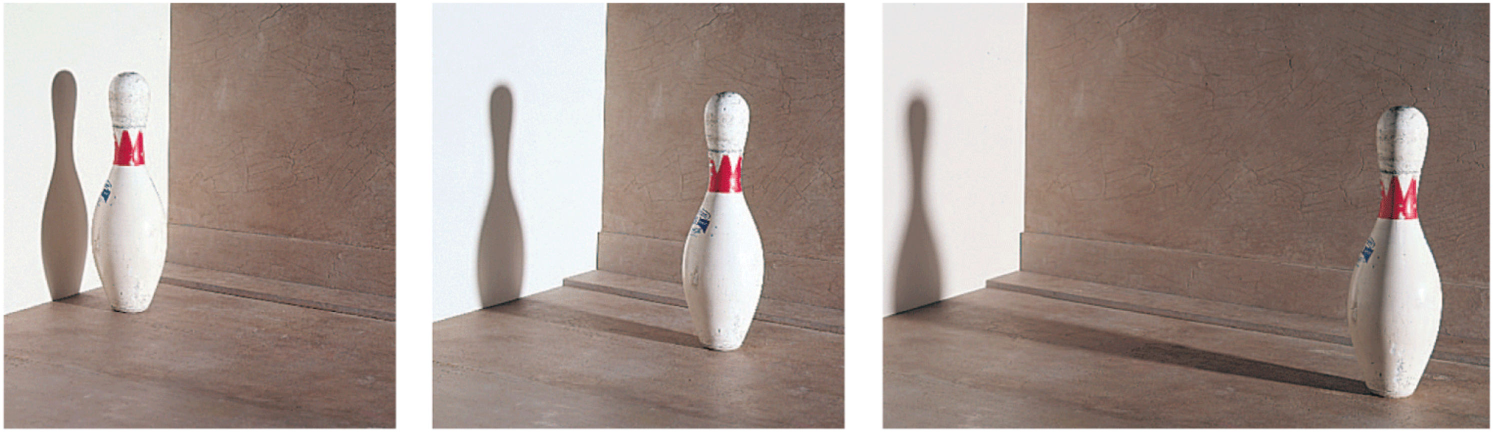
a b

# 27.6 Shadows

a. An object held close to a wall casts a sharp shadow.

b. As the object is moved farther away, penumbras are formed and cut down on the umbra.

c. When it is very far away, all the penumbras mix together into a big blur.



a b c

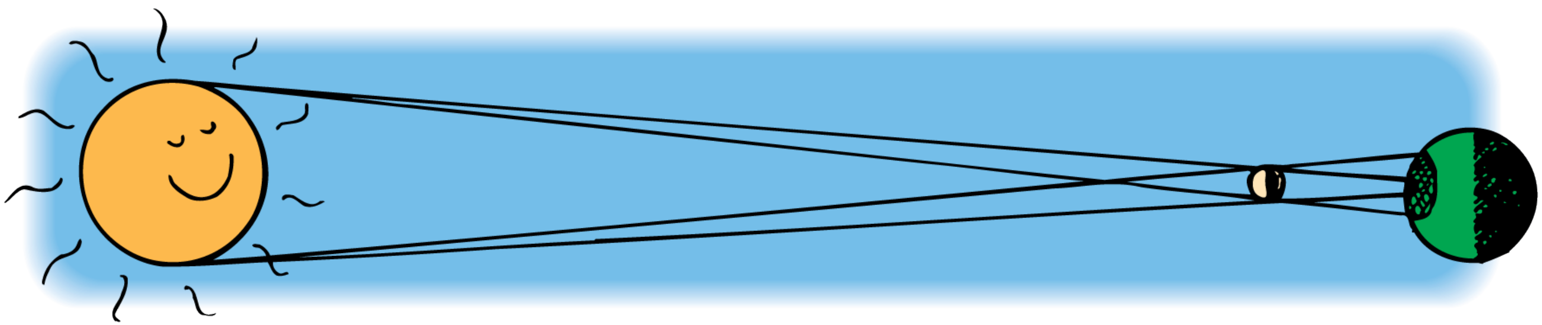
# 27.6 Shadows

A penumbra occurs when the moon passes between Earth and the sun—during a solar eclipse.

The moon's shadow barely reaches Earth.

If you stand in the umbra shadow, you experience brief darkness during the day.

If you stand in the penumbra, you experience a partial eclipse. The sunlight is dimmed, and the sun appears as a crescent.

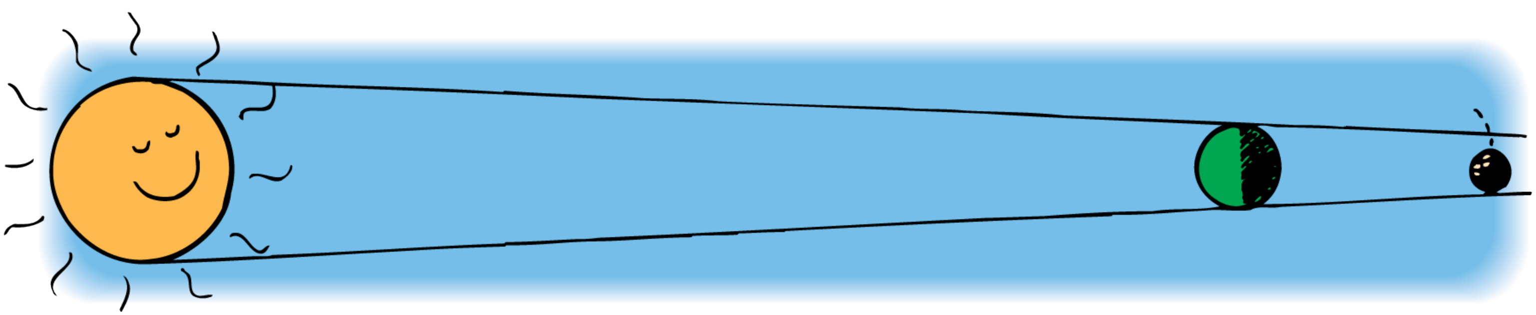


# 27.6 Shadows

Earth, like most objects in sunlight, casts a shadow.

This shadow extends into space, and sometimes the moon passes into it. When this happens, we have a lunar eclipse.

A lunar eclipse can be seen by all observers on the nighttime half of Earth.



# 27.6 Shadows

Shadows also occur when light is bent in passing through a transparent material such as water.

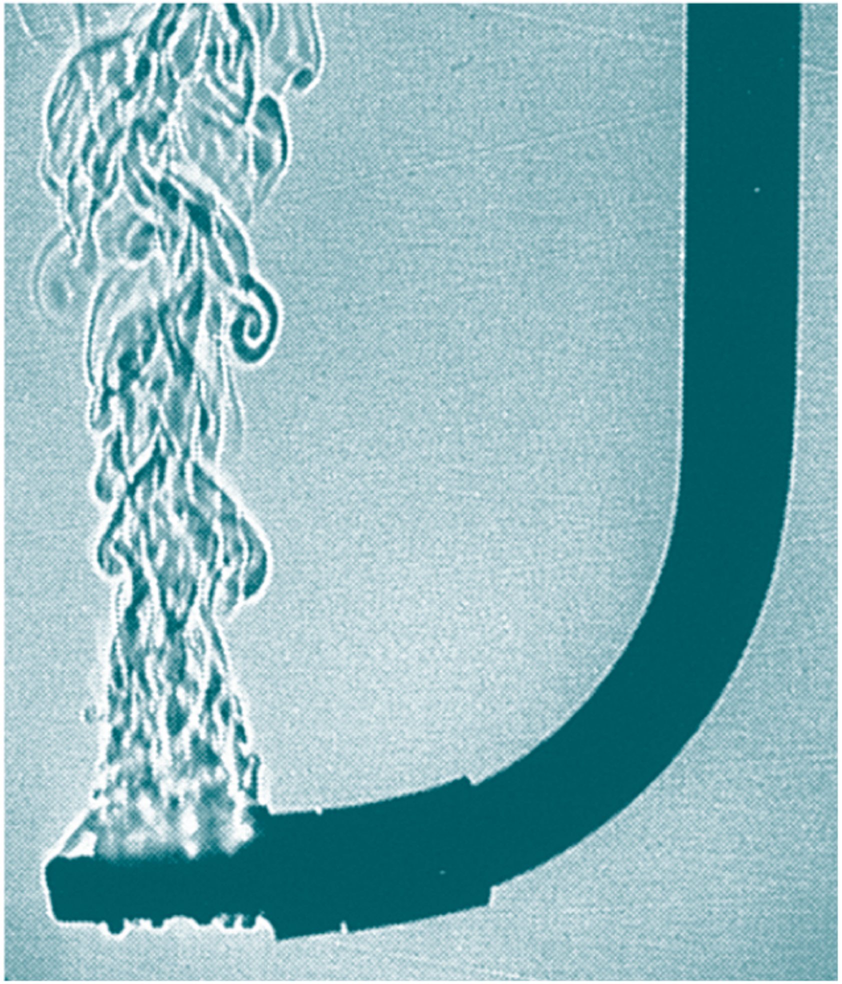
Light travels at slightly different speeds in warm and in cold water.

The change in speed causes light to bend, just as layers of warm and cool air in the night sky bend starlight and cause twinkling.

Some light gets deflected a bit and leaves darker places on the wall. The shapes of the shadows depend on how the light is bent.

# 27.6 Shadows

A heater at the tip of this submerged J-tube produces convection currents in the water. They are revealed by shadows cast by light that is deflected differently by the water of different temperatures.



# 27.6 Shadows

## think!

Why are lunar eclipses more commonly seen than solar eclipses?

# 27.6 Shadows

## think!

Why are lunar eclipses more commonly seen than solar eclipses?

*Answer:*

There are usually two of each every year. However, the shadow of the moon on Earth is very small compared with the shadow of Earth on the moon. Only a relatively few people are in the shadow of the moon (solar eclipse), while everybody who views the nighttime sky can see the shadow of Earth on the moon (lunar eclipse).

# 27.6 Shadows

CONCEPT CHECK

What causes the formation of shadows?

# 27.7 Polarization

Light that reflects at glancing angles from nonmetallic surfaces, such as glass, water, or roads, vibrates mainly in the plane of the reflecting surface.

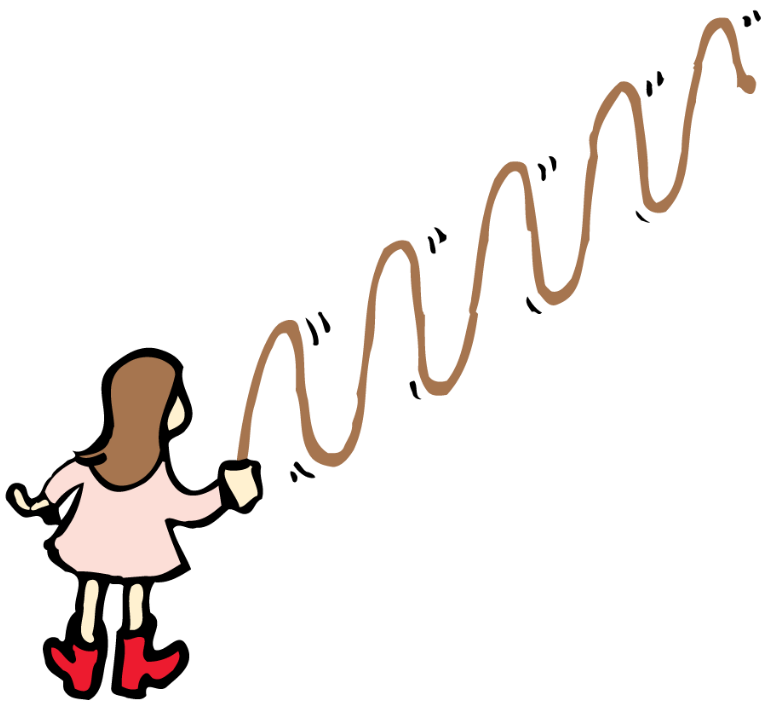
# 27.7 Polarization

Light travels in waves. The fact that the waves are transverse—and not longitudinal—is demonstrated by the phenomenon of **polarization.**

- If you shake the end of a horizontal rope, a transverse wave travels along the rope.
- The vibrations are back and forth in one direction.
- The wave is said to be polarized.

# 27.7 Polarization

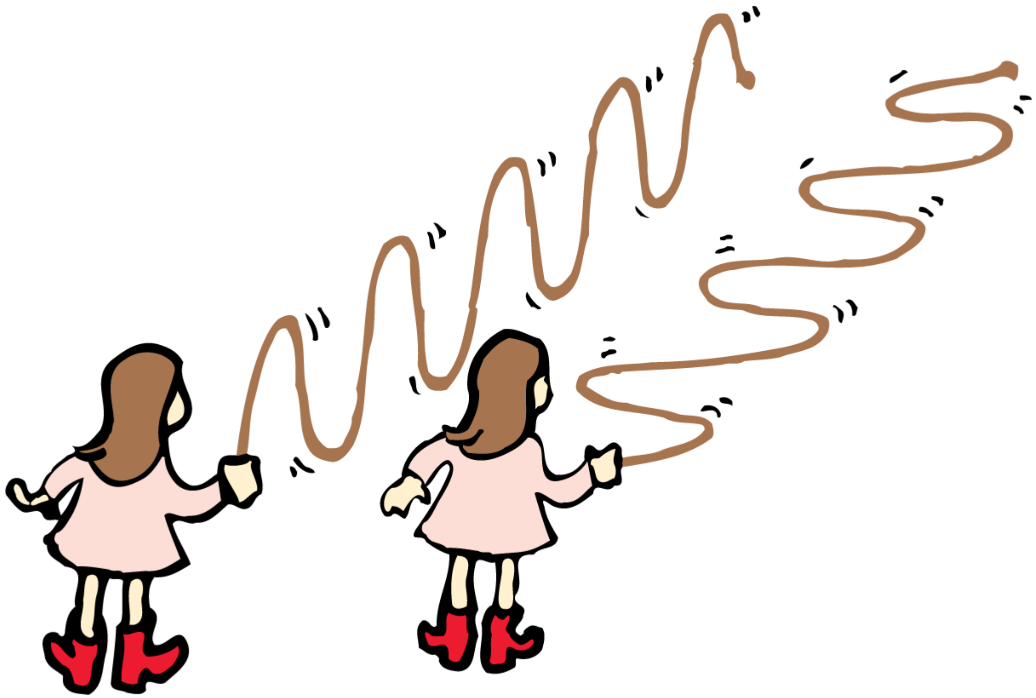
If the rope is shaken up and down, a vertically polarized wave is produced. The waves traveling along the rope are confined to a vertical plane.



# 27.7 Polarization

If the rope is shaken up and down, a vertically polarized wave is produced. The waves traveling along the rope are confined to a vertical plane.

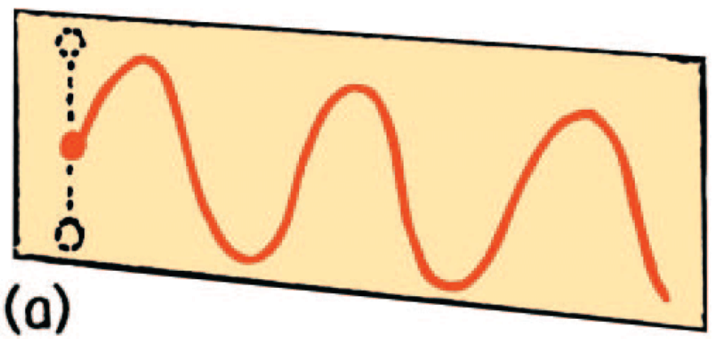
If the rope is shaken from side to side, a horizontally polarized wave is produced.



# 27.7 Polarization

A vibrating electron emits a polarized electromagnetic wave.

A vertically vibrating electron emits vertically polarized light.

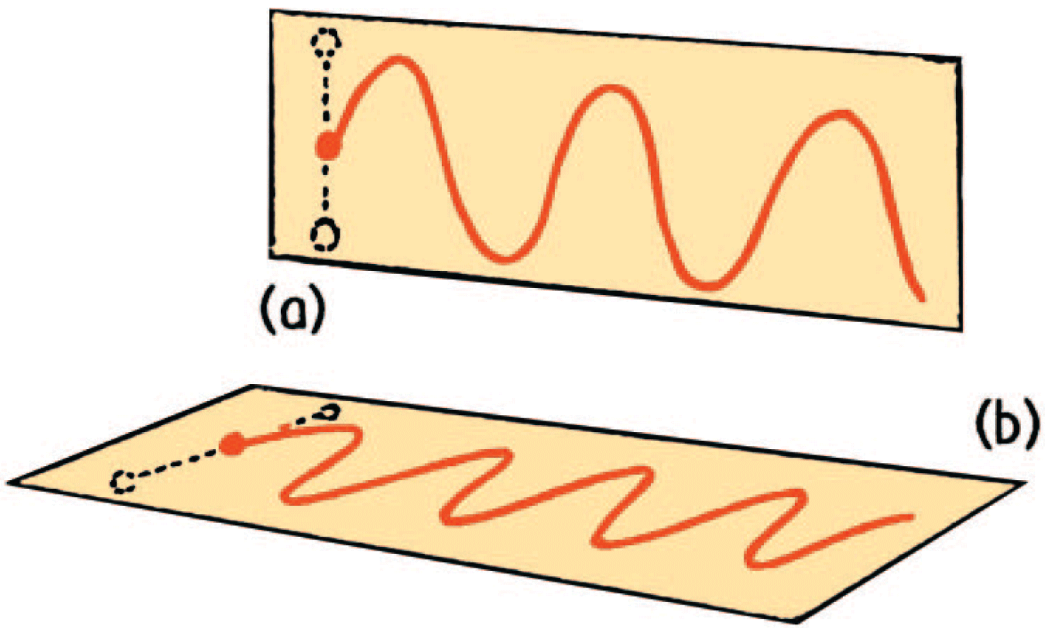

(a)

# 27.7 Polarization

A vibrating electron emits a polarized electromagnetic wave.

A vertically vibrating electron emits vertically polarized light.

A horizontally vibrating electron emits horizontally polarized light.



# 27.7 Polarization

An incandescent or fluorescent lamp, a candle flame, or the sun all emit light that is not polarized.

The electrons that produce the light vibrate in random directions.

# 27.7 Polarization

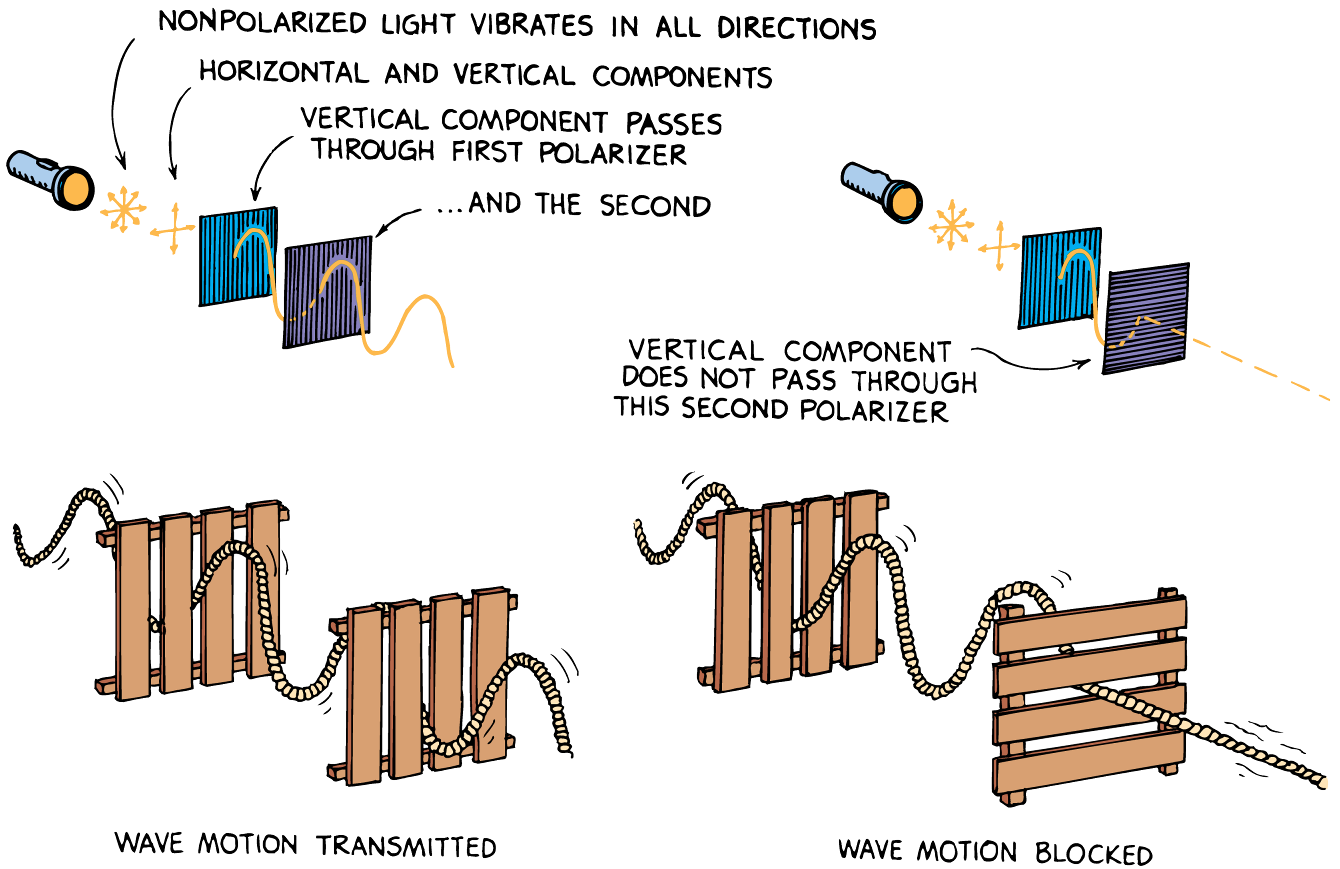
When light shines on a polarizing filter, the light that is transmitted is polarized.

The filter is said to have a polarization axis that is in the direction of the vibrations of the polarized light wave.

Light passes through two polarizing filters when the polarization axes are aligned but not when they are crossed at right angles.

# 27.7 Polarization

A rope analogy illustrates the effect of crossed sheets of polarizing material.



# 27.7 Polarization

Try skipping flat stones across the surface of a pond.

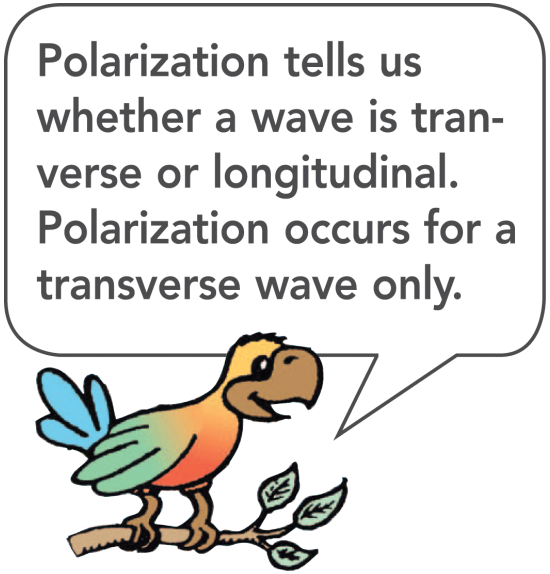
- Stones with flat sides parallel to the water bounce (“reflect”).
- Stones with flat sides at right angles to the surface penetrate the water (“refract”).
- Light behaves similarly. The flat side of a stone is like the plane of vibration of polarized light.

Light reflecting from nonmetallic surfaces, such as glass, water, or roads, vibrates mainly in the plane of the reflecting surface.

# 27.7 Polarization

So glare from a horizontal surface is horizontally polarized.

The axes of polarized sunglasses are vertical so that glare from horizontal surfaces is eliminated.



# 27.7 Polarization

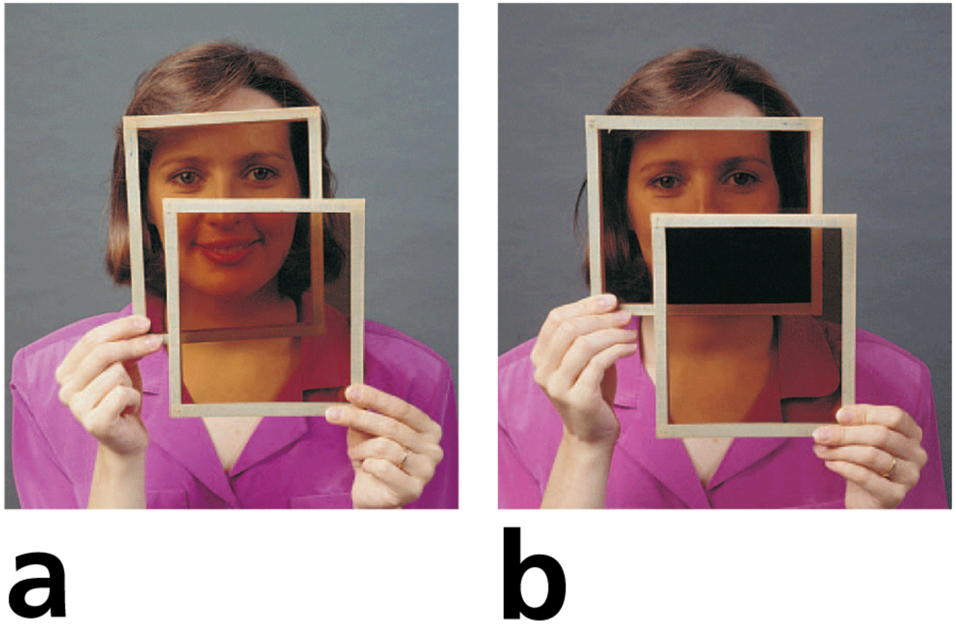
a. Light is transmitted when the axes of the polarizing filters are aligned.

a

# 27.7 Polarization

a. Light is transmitted when the axes of the polarizing filters are aligned.

b. Light is absorbed when they are at right angles to each other.

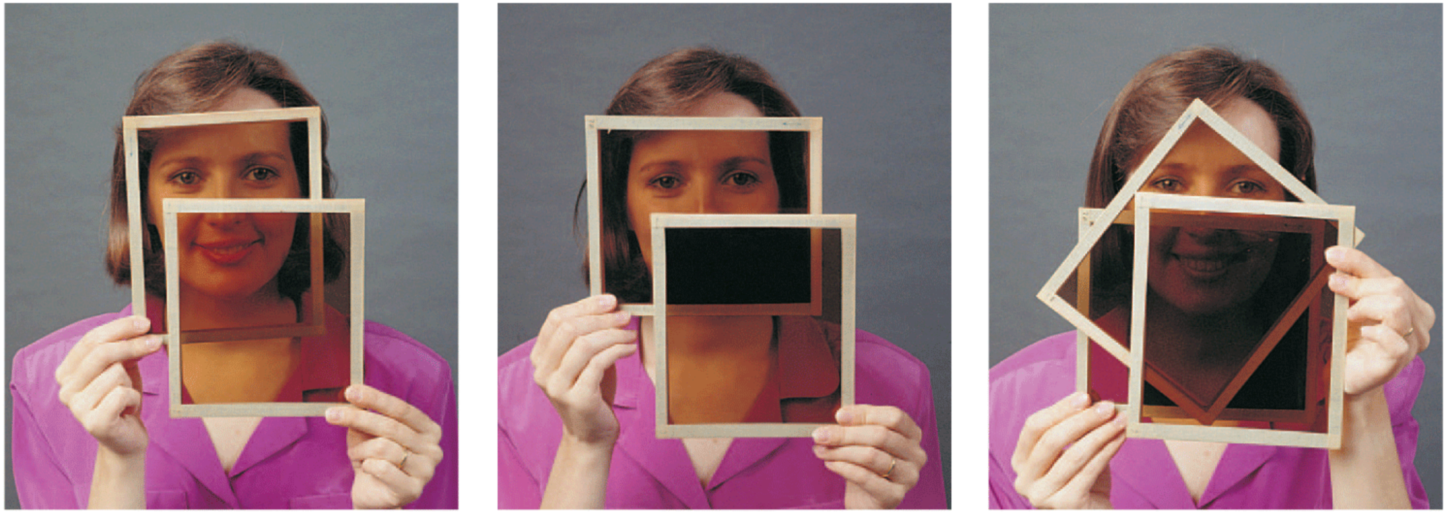


# 27.7 Polarization

a. Light is transmitted when the axes of the polarizing filters are aligned.

b. Light is absorbed when they are at right angles to each other.

c. Surprisingly, when a third filter is sandwiched between the two crossed ones, light is transmitted. (The explanation involves vectors!)



a b c

# 27.7 Polarization

CONCEPT CHECK

**Why is glare from a horizontal surface horizontally polarized?**

# 27.8 Polarized Light and 3-D Viewing

A pair of photographs or movie frames, taken a short distance apart (about average eye spacing), can be seen in 3-D when the left eye sees only the left view and the right eye sees only the right view.

# 27.8 Polarized Light and 3-D Viewing

Vision in three dimensions depends on both eyes giving impressions simultaneously from slightly different angles.

The combination of views in the eye-brain system gives depth.

A pair of photographs taken a short distance apart is seen in 3-D when the left eye sees only the left view and the right eye sees only the right view.

# 27.8 Polarized Light and 3-D Viewing

Slide shows or movies can project a pair of views through polarization filters onto a screen with their polarization axes at right angles to each other.

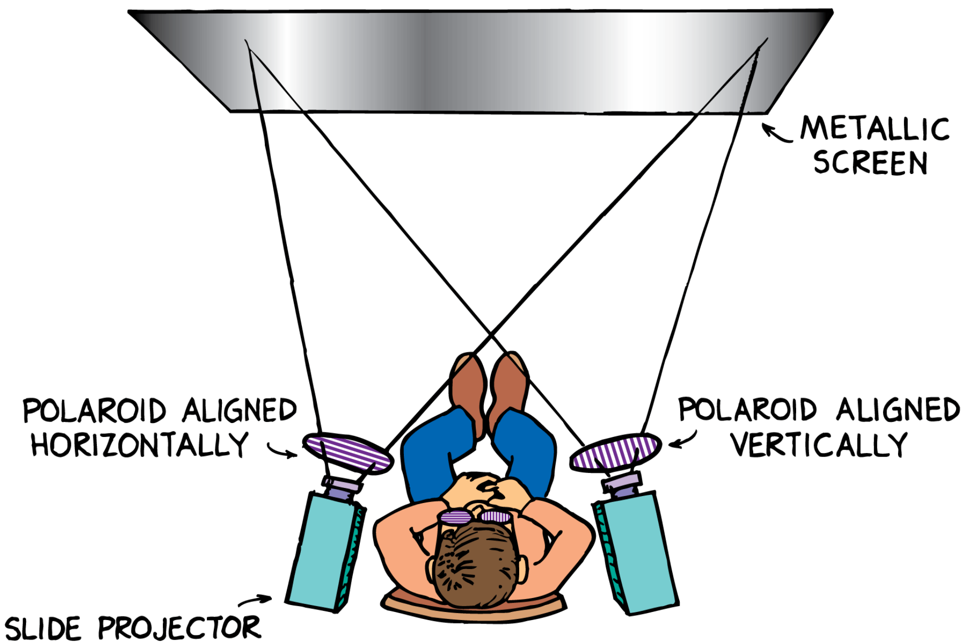
The overlapping pictures look blurry to the naked eye.

To see in 3-D, the viewer wears polarizing eyeglasses with the lens axes also at right angles.

Each eye sees a separate picture. The brain interprets the two pictures as a single picture with a feeling of depth.

# 27.8 Polarized Light and 3-D Viewing

A 3-D slide show uses polarizing filters. The left eye sees only polarized light from the left projector; the right eye sees only polarized light from the right projector.



# 27.8 Polarized Light and 3-D Viewing

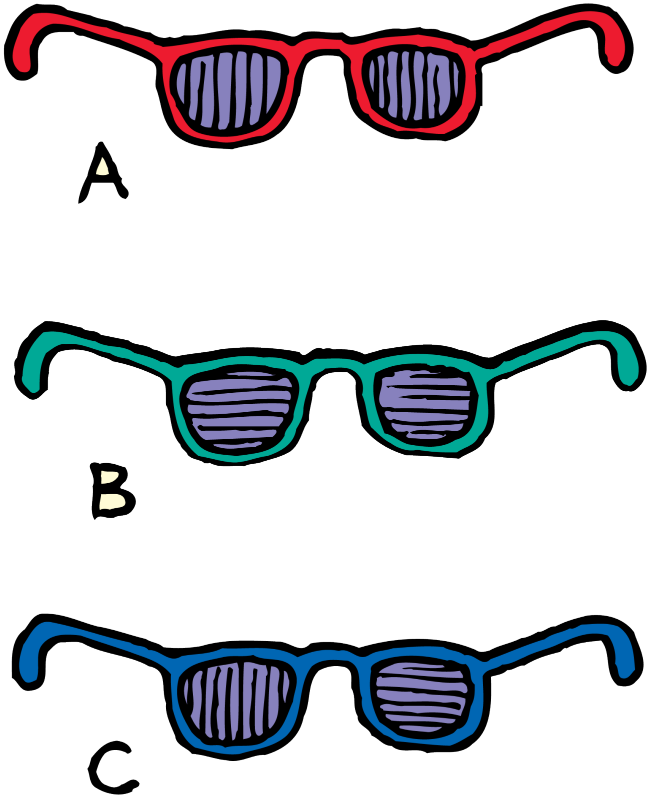
Depth is also seen in computer-generated stereograms.

In computer-generated stereograms, the slightly different patterns are hidden from a casual view. In your book, you can view the message of Figure 27.20 with the procedure for viewing Figure 27.18. Once you've mastered the viewing technique, head for the local mall and check the variety of stereograms in posters and books.

# 27.8 Polarized Light and 3-D Viewing

## think!

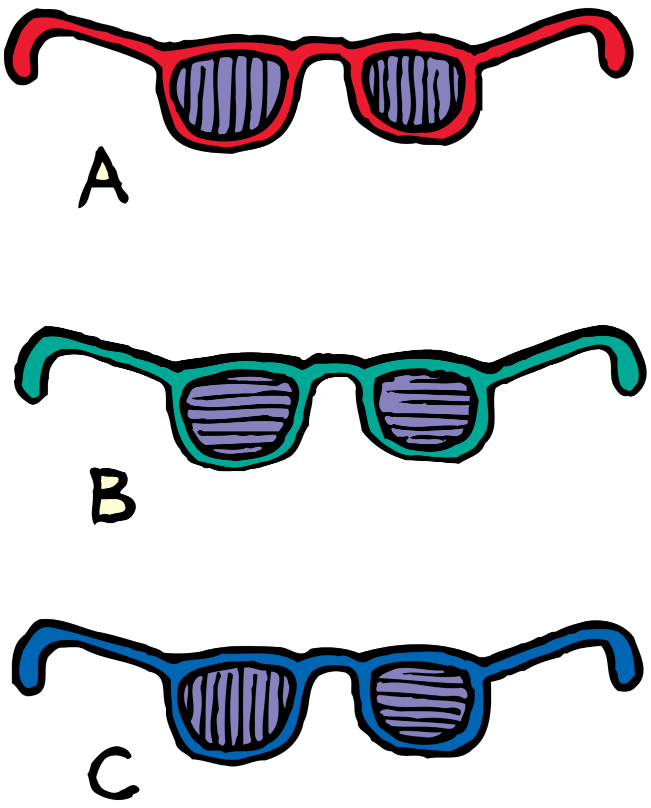
Which pair of glasses is best suited for automobile drivers? (The polarization axes are shown by the straight lines.)



# 27.8 Polarized Light and 3-D Viewing

## think!

Which pair of glasses is best suited for automobile drivers? (The polarization axes are shown by the straight lines.)

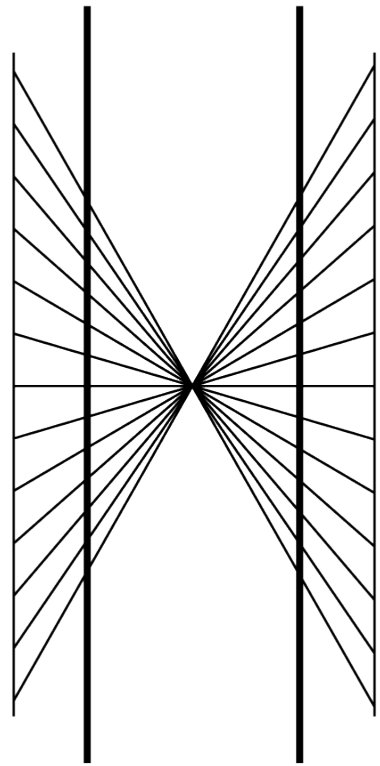



*Answer:*

Pair A is best suited because the vertical axes block horizontally polarized light that composes much of the glare from horizontal surfaces. (Pair C is suited for viewing 3-D movies.)

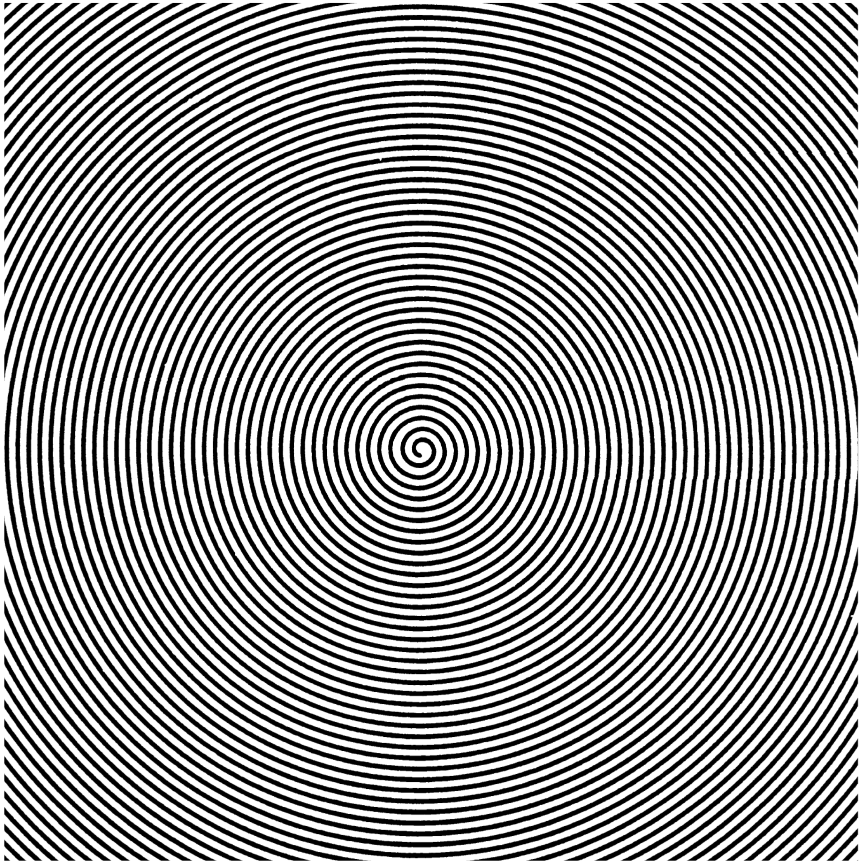
# 27.8 Polarized Light and 3-D Viewing

## Try these optical illusions.



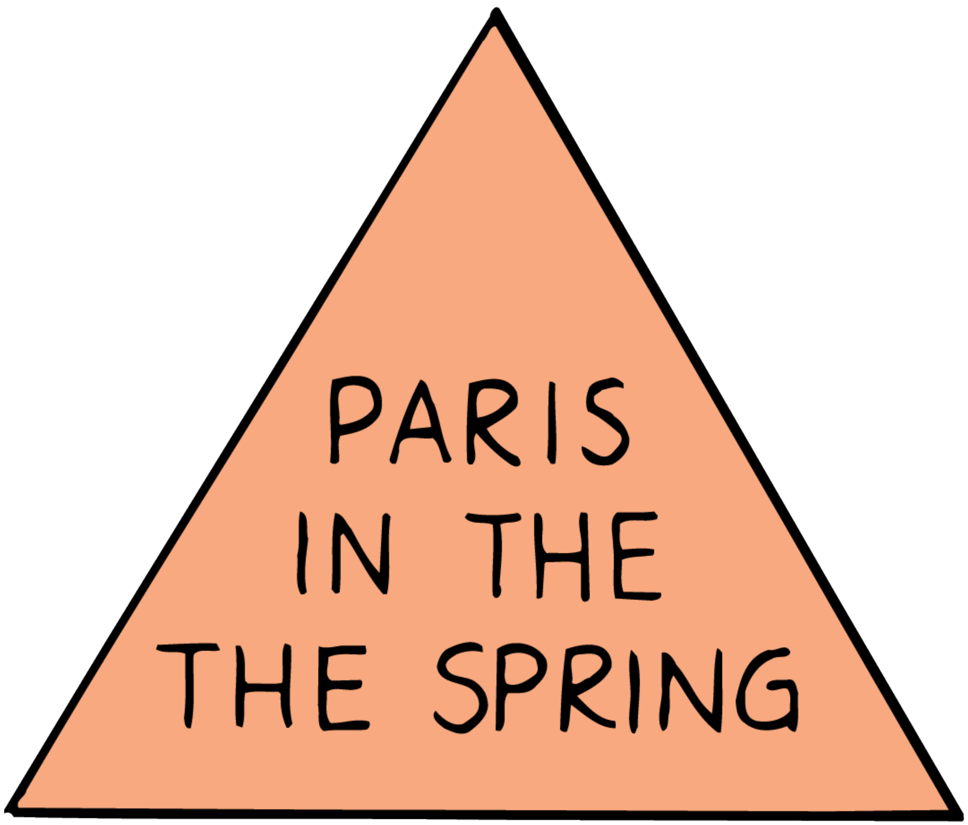
Are the vertical lines parallel?

# 27.8 Polarized Light and 3-D Viewing



Do these lines move?

# 27.8 Polarized Light and 3-D Viewing




**What does this sign read?**

# 27.8 Polarized Light and 3-D Viewing

CONCEPT CHECK

**How can you see photographs or movies in 3-D?**

# Assessment Questions

1. Scientists now agree that light is composed of
   a. only electromagnetic waves.
   b. only photons.
   c. electromagnetic waves and particles called photons.
   d. an unknown source.

# Assessment Questions

1. Scientists now agree that light is composed of
   a. only electromagnetic waves.
   b. only photons.
   c. electromagnetic waves and particles called photons.
   d. an unknown source.

Answer: C

# Assessment Questions

2. The time it takes light to travel across the orbit of Earth is about
   a. less than a second.
   b. 8 minutes.
   c. 22 minutes.
   d. 4 years.

# Assessment Questions

2. The time it takes light to travel across the orbit of Earth is about
   a. less than a second.
   b. 8 minutes.
   c. 22 minutes.
   d. 4 years.

Answer: C

# Assessment Questions

3. All of the following are part of the electromagnetic spectrum EXCEPT
   a. light.
   b. sound.
   c. radio waves.
   d. X-rays.

# Assessment Questions

3. All of the following are part of the electromagnetic spectrum EXCEPT
   a. light.
   b. sound.
   c. radio waves.
   d. X-rays.

Answer: B

# Assessment Questions

4. Strictly speaking, the photons of light that shine on glass are
   a. the ones that travel through and exit the other side.
   b. not the ones that travel through and exit the other side.
   c. absorbed and transformed to thermal energy.
   d. reflected.

# Assessment Questions

4. Strictly speaking, the photons of light that shine on glass are
   a. the ones that travel through and exit the other side.
   b. not the ones that travel through and exit the other side.
   c. absorbed and transformed to thermal energy.
   d. reflected.

Answer: B

# Assessment Questions

5. Light that is not transmitted by opaque materials is
   a. converted to internal energy in the material.
   b. mainly reflected.
   c. mainly refracted.
   d. transmitted at a lower frequency.

# Assessment Questions

5. Light that is not transmitted by opaque materials is
   a. converted to internal energy in the material.
   b. mainly reflected.
   c. mainly refracted.
   d. transmitted at a lower frequency.

Answer: A

# Assessment Questions

6. When the shadow of the moon falls on Earth we have a
   a. lunar eclipse.
   b. solar eclipse.
   c. solar eclipse if it's daytime and lunar eclipse if it's nighttime.
   d. very dangerous event.

# Assessment Questions

6. When the shadow of the moon falls on Earth we have a
   a. lunar eclipse.
   b. solar eclipse.
   c. solar eclipse if it’s daytime and lunar eclipse if it’s nighttime.
   d. very dangerous event.

Answer: B

# Assessment Questions

7. Polarization occurs when waves of light are
   a. undergoing interference.
   b. longitudinal.
   c. aligned.
   d. in harmony.

# Assessment Questions

7. Polarization occurs when waves of light are
   a. undergoing interference.
   b. longitudinal.
   c. aligned.
   d. in harmony.

Answer: C

# Assessment Questions

8. The best way to view something in 3-D is to
   a. have keen eyesight.
   b. use two eyes.
   c. use only one eye.
   d. be slightly cross-eyed.

# Assessment Questions

8. The best way to view something in 3-D is to
   a. have keen eyesight.
   b. use two eyes.
   c. use only one eye.
   d. be slightly cross-eyed.

Answer: B